Antimicrobial Activity of *Capsicum* Essential Oil of Peppers

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ABSTRACT:*In this work the antimicrobial activity and the economic viability analysis of the essential oil extracted from the hybrid formed by the seeds species of the Murupi (Capsicum chinense), Criollos de Morellos (Capsicum annuum) and Finger of the young (Capsicum baccatum). The essential oil of the pepper was obtained by the steam drag process and for this extraction, the Soxhlet method was used. For the determination of the antimicrobial activity of the oil the disc diffusion method was used for the strains of Bacillus cereus, Staphylococcus aureus and Escherichia coli. The results point out the resistance of the tested strains to the essential oil of the respective pepper and, in terms of financial and economic aspects, this was not feasible on a small scale. It is suggested that other microorganisms be tested and, later, that studies be carried out with the purpose of characterizing the studied oil chemically for proper application in the agroindustry.*

KEYWORDS *-Capsicum annuum, Capsicum baccatum, Capsicum chinense, capsaicina, pathogenic Microorganisms.*

I. INTRODUCTION

Capsicum peppers are unique to the American continent and represent a valuable part of Brazilian biodiversity [1]. The cultivation of peppers in Brazil is of great importance, both for the characteristics of profitability, especially when the producer adds value to the product, as well as for the social importance, for employing high labor [2].

This segment of Brazilian agribusiness is significant for Brazil, with a relevant export, as it stands out the use of the various peppers in the pharmaceutical, food and cosmetic industries. Pepper seeds are used to enhance the taste and aroma of food, while essential oils are used in the production of perfumes, insecticides and as a medicinal ingredient. In addition, essential oils also play a significant role in preventing or delaying the process of food deterioration due to its antioxidant and antimicrobial activities [3].

Peppers of the genus *Capsicum*, belonging to the family *Solanaceae* are widely cultivated throughout the Brazilian territory, with a rich variation of sizes, colors, flavors and pungency. They have a great genetic diversity and they have more than 30 species identified, but of the species of this genus, five of them are the most common: Capsicum annuum; *C. bacccatum; C. chinense; C. frutescen*s and *C. pubescens* [4].

The peppers considered pungent in the genus Capsicum are recognized by the contents of vitamins, minerals, natural pigments and by the sensoriality. Its main source of pungency is associated with alkaloids called capsaicinoids, which produce sensations of burning, spicy and heat. The chemical compound capsaicin (8-methyl-N-vanillyl-1-6-nonamide) is the active component of these peppers known internationally as chilli or burnt peppers. It is irritating to mammals, including humans, as it sensitizes the cells and produces a burning sensation in any tissue that comes in contact [5,6].

Due to the toxicity, the risk of diseases caused by the intense consumption of synthetic additives and the preference of the consumers for healthy foods, there is an increasing interest in the development of products with natural additives and free of preservatives, that are able to preserve the foods of the undesirable changes. Several peppers have shown commercial interest due to this possibility of extraction of essential oils that have substances with antibacterial action, antifungal activities and insecticide in their properties and assist in the conservation process [7, 8,9].

Essential oils were defined by the International Standart Organization (ISO) as products obtained from plant parts by steam distillation, are complex mixtures of volatile substances, lipophilic, usually odoriferous and liquid, and their main characteristic is the volatility , thus differing from fixed oils, a mixture of lipid substances, generally obtained from seeds [10]. Classified as Generally Recognized As Safe, or GRAS, they are safe for health and have proven antibacterial and antioxidant properties [11]. In addition, conclusions point to future studies of essential oils as therapeutic and preventive agents for the treatment of various diseases [12]. Essential oils are formed by structures of terpenes, sesquiterpenes,phenolics, phenylpropanoid, non-terpene aliphatic, heterocyclic and chemical functions of alcohols, ketones, aldehydes, carboxylic acids, esters, oxides, acetates and others [13].

Researches show that essential oils exert activity in several microorganisms, presenting high application potential [14]. One of these is the use of essential oils as antimicrobial and flavoring agents in food, to ensure the quality of the product and, consequently, food safety, since they are natural constituents, making them useful and as healthier alternatives for the food industries and are well accepted by consumers.

Some authors have shown that spices and their derivatives, such as extracts, essential oils and isolated chemical compounds, have satisfactory results in inhibiting opportunistic pathogenic microorganisms, primary pathogens, deteriorating organisms, and / or inhibiting the production of microbial toxins [15,16].

Essential oils have been considered as natural preservatives and can be used as an additional method of controlling the growth and survival of pathogenic and / or deteriorating microorganisms in food [17].

The antimicrobial activity of essential oils is clear, but the mechanism of antimicrobial action is not yet fully elucidated [18]. Considering the diversity of different groups of chemical compounds present in the essential oils, it is likely that the antibacterial activity is not attributable to a specific mechanism, but that there are several targets in the cell, as previously observed, such as cytoplasmic membrane alterations, proton motive, electron flow, active transport, coagulation of cell contents, inhibition of protein synthesis or alteration in the glucose reserve. Not all of these mechanisms reach separate targets, some of which may occur as a consequence of another mechanism [19].

Several studies on the antimicrobial properties of essential oils have been performed, and their ability to control food-borne pathogens has been demonstrated [19,20,21,22].

In the present experiment, we report the results of a study to evaluate the antimicrobial functional properties and economic viability of pepper essential oil resulting from a hybrid formed from the seeds of the species Murupi (*Capsicum chinense)*, Criollo de Morellos (*Capsicum annuum*) and Finger (*Capsicum baccatum*) against pathogenic microorganisms of interest in the health area: *Escherichia coli, Staphylococcus aureus* and *Bacillus cereus.*

II. METHODOLOGY

The research was carried out in the physicochemical and microbiology laboratories of the Uberaba University. The essential oil of the pepper was obtained by the steam-dragging process, by the Soxhlet method, and the extraction was carried out using hexane and acetone separately. The technique used for the antimicrobial activity of the oil was paper disc diffusion and the reference strains of pathogenic microorganisms used were *Escherichia coli, Staphylococcus aureus* and *Bacillus cereus* [23]. After incubation of the plates at 37°C for 24 hours, the diameters of inhibition halos were measured in millimeters [24]. The economical financial feasibility study of essential oil extraction was carried out.

III. RESULTS AND DISCUSSION

In this research, the Soxhlet method was chosen for the extraction process of the essential oil because it is one of the most used for the extraction of essential oils in general [25]. With the extraction of 40.09g of seeds for approximately 7 hours using hexane as solvent, it was possible to obtain 3g of essential oil. A small amount, with a percent yield of 7.48%, but acceptable.

As it is a new pepper, formed from the hybridization process of three different species, Murupi (*Capsicum chinense*), Criollo de Morellos (*Capsicum annuum*) and Finger of a girl (*Capsicum baccatum*), there is no information in the literature regarding its functional antimicrobial and

production characteristics, and it was not possible to find records of the use of the essential oil of the hybrid formed in order to perform a comparative analysis. Thus, a comparative study with the scientific literature of the results obtained using the three pepper species was carried out separately, that is, without being submitted to a process of genetic improvement.

The antimicrobial activity of the oil was analyzed in three replicates, according to Table 1 below and in all the replicates the oil was not shown with the effective action against the strains tested. Through descriptive statistical analysis, it was verified that there was no significant difference at the 5% level, between the results of each experiment.

These results are opposite to the results found by Dorantes et al. (2002) where *Capsicum annum* pepper extract showed inhibitory activity for *L. monocytogenes, Salmonella typhimurium, B. cereus* and *S. aureus* [26]. These results also differ from the results obtained by the study by Gurnania et al. (2016), with *Capsicum frutescens* L., where inhibitory activity was especially notable (zone of inhibition ≥13 mm) against *Pseudomona aeruginosa, Klebsilla pneumoniae, Staphylococcus aureus* and *Candida albicans* [27]. Carvalho et al. (2010) also found inhibitory activity in the species *Capsicum baccatum, Capsicum annum* and *Capsicum frutescens* against *S. aureus; E. faecalis; Salmonella enteritidis* and *E. coli* [28].

Table 1. Antimicrobial activity of crude seed extracts of Murupi (Capsicum chinense), Criollos de Morellos (Capsicum annuum) and Young Finger (Capsicum baccatum) seeds.

Microorganisms	**Inhibition Halos (mm)***					
	n Hexano			**Acetona**		
	Repetitions					
	1	**2**	**3**	**1**	**2**	**3**
Escherichia coli	0	0	0	0	0	0
S. aureus	0	0	0	0	0	0
Bacillus cereus	0	0	0	0	0	0

Source: *MicrobiologyLaboratory_UNIUBE.*
**Milimetros*

The absence of antimicrobial activity of this pepper can be related to the reduction of the characteristic pungence of the same one when forming the hybrid, in comparison with the isolated species, without being submitted to a process of genetic improvement. The results found, cited above, are similar to the results found by some authors who refer to the antibacterial activity related to the pungency or capsaicin concentration of these plants [5,29,30].

The characteristic of the pungence of each pepper is formed by the capsaicinoids. Its accumulation in *Capsicum peppers* may vary according to the stage of development, age and size of the plant. In the early stages of development the biosynthesis of capsaicinoids begins, and when it reaches the maximum of maturation, the concentration of the substance gradually decreases due to the oxidation by *Capsicum* peroxidase due to the presence of hydrogen peroxide [31].

Some authors have concluded that for the paper disc diffusion methodology, the diameter of the inhibition halo formed is related to the content of capsaicinoids in each Capsicum species, which in turn is directly associated with the value of its pungency in HUS, seen that the species that resulted in greater inhibition halos had a higher concentration of capsaicinoids, mainly capsaicin. The authors found that Cumari-do-Pará pepper, which has a pungency of 219,020 SHU and 1.22% of capsaicin, presented a 24.43mm inhibition halo of the S. aureus microorganism. On the other hand, Chili Pepper, with 47,180 SHU and 0.27% capsaicin, presented a 14.61mm inhibition halo of the same microorganism [32].

Thus, with the results obtained in this experiment, it is suggested that other microorganisms be tested and, later, that studies be carried out with the purpose of characterizing the obtained oil chemically and quantify the capsaicinoid content of the respective pepper for adequate application in the agroindustry.

IV. CONCLUSION

According to the results obtained, using the official methodology, it was concluded that pepper essential oil obtained from the hybridization of seeds of Murupi (*Capsicum chinense*), Criollos de Morellos (*Capsicum annuum*) and Finger of *Capsicum baccatum*, when tested in the pathogenic bacteria *Bacillus cereus, Staphylococcus aureus* and *Escherichia coli*, were found inefficient to inhibit their growth, and that their extraction process proved to be economically unfeasible. With the results obtained, it is suggested that other microorganisms be tested and later that studies are carried out with the purpose of characterizing the studied oil chemically and quantify the capsaicinoid content of the respective pepper for adequate application in the agroindustry.

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